

CLAIMS

What is claimed is:

- 5 1. A membrane filtration system comprising:
 a piston, said piston separating a feed chamber from a retentate chamber;
 a membrane filtration element; and
 a differential pressure activated (DPA) valve which controls retentate discharge;
 wherein pressure recovery is provided by a pressure difference between the feed chamber and
10 the retentate chamber acting on the piston.
2. The membrane filtration system of claim 1 wherein the DPA valve is hydraulically
 operated.
- 15 3. The membrane filtration system of claim 1 wherein operation of the DPA valve is
 determined by relative pressure in the feed chamber and the retentate chamber.
4. The membrane filtration system of claim 3 wherein the DPA valve operates
 automatically in accordance with pumping of the piston.
- 20 5. The membrane filtration system of claim 1 wherein the piston comprises a piston
 shaft.
6. The membrane filtration system of claim 5 wherein a recovery ratio of the
25 membrane filtration element is determined by a cross-sectional area of the piston shaft.
7. The membrane filtration system of claim 6 wherein the piston shaft is easily
 replaceable, thereby enabling rapid change of the recovery ratio.

8. The membrane filtration system of claim 1 further comprising a pressure relief valve.

9. The membrane filtration system of claim 1 comprising a single cylinder.

10. The membrane filtration system of claim 1 having a diameter of less than approximately four inches.

11. The membrane filtration system of claim 10 having a diameter of less than approximately two inches.

12. The membrane filtration system of claim 1 having a length of less than approximately twenty-four inches.

13. The membrane filtration system of claim 12 having a length of less than approximately fifteen inches.

14. The membrane filtration system of claim 1 having a weight of less than five pounds.

15. The membrane filtration system of claim 14 having a weight of less than three pounds.

16. The membrane filtration system of claim 1 wherein said membrane filtration element comprises a reverse osmosis element.

17. The membrane filtration system of claim 16 wherein said reverse osmosis element comprises a spiral wrapped element.

18. The membrane filtration system of claim 17 wherein said spiral wrapped element comprises:

5 at least one membrane; and
at least one thin feed spacer.

19. The membrane filtration element of claim 18 wherein said at least one thin feed spacer comprises a plastic web mesh.

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20. The membrane filtration system of claim 18 wherein said at least one thin feed spacer is less than approximately .025 inches thick.

21. The membrane filtration system of claim 20 wherein said at least one thin feed
15 spacer is less than approximately .011 inches thick.

22. The filtration system of claim 18 wherein said at least one thin feed spacer provides for a reduction in an amount of total dissolved solids at a surface of said membrane.

20 23. The filtration system of claim 1 wherein the pressure recovery is great enough to enable manual operation of the system.

24. The filtration system of claim 23 wherein the pressure recovery is about fifty percent.

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25. A method of filtering a substance comprising the steps of:
pumping the substance with a piston, wherein the piston separates a feed chamber and a retentate chamber;

passing the substance through at least one membrane filtration element, thereby separating the substance into permeate and retentate; and
discharging the retentate using a differential pressure activated (DPA) valve.

5 26. The method of claim 25 wherein the passing step comprises passing the substance through a reverse osmosis filtration element.

 27. The method of claim 25 wherein the discharging step comprises operating the DPA valve hydraulically.

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 28. The method of claim 25 wherein the discharging step comprising operating the DPA valve according to the relative pressure in the feed chamber and the retentate chamber.

 29. The method of claim 28 wherein the discharging step comprising operating the
15 DPA valve automatically as the substance is pumped.

 30. The method of claim 25 wherein the pumping step comprises utilizing a pressure difference between the feed chamber and the retentate chamber acting on the piston to reduce the force necessary to pump the substance.